

CLAIMS

1. A method of cooling during grinding in which liquid nitrogen is applied to the contact region between a rotating grinding wheel and a workpiece for the purpose of cooling the wheel and workpiece without marking or staining unground regions of the workpiece surface by contact with the coolant.
2. A method as claimed in claim 1 wherein the workpiece is glass and the grinding wheel acts to grind a flat or profiled surface of the workpiece, and the liquid nitrogen is directed towards the surface of the glass or the edge of the wheel or into the region immediately in the vicinity of the wheel and workpiece point of contact.
3. A method of grinding as claimed in claim 1 wherein the workpiece is a glass plate, and the grinding wheel acts to grind the edge of the plate, and the liquid nitrogen is directed towards the edge of the glass, or the edge of the wheel, or into the nip between the workpiece and the rotating grinding wheel.
4. A method as claimed in any of claims 1 to 3 wherein the workpiece is rotated during grinding.
5. A grinding machine for performing the method of any of claims 1 to 4 comprising:-
 - 1) a machine bed,
 - 2) a workpiece holder,
 - 3) workpiece drive means for moving the workpiece holder and a workpiece carried thereon
 - 4) a grinding wheel,
 - 5) a drive by which the grinding wheel is rotated,

- 6) a wheelhead carrying the wheel and drive therefor,
 - 7) a slideway by which the wheelhead can move relative to the workpiece,
 - 8) wheelhead drive means for moving the wheelhead,
 - 9) a source of liquid nitrogen,
 - 10) valve means and pipeline means communicating between the source and a nozzle,
 - 11) drive means for positioning the nozzle relative to the wheel and workpiece, and
 - 12) a control system for controlling the operation of each of the drive means and the valve means to supply liquid nitrogen to the grinding region during grinding and to control the nozzle drive means during grinding so as to move the nozzle to direct liquid nitrogen towards the region of grinding contact between the wheel and workpiece.
6. A grinding machine by which a workpiece is ground by engagement with a rotating grinding wheel, comprising a workpiece support, a grinding wheel, drive means therefor, and a wheelhead and drive for moving the wheelhead and therefore the wheel relative to the workpiece, a source of liquid nitrogen under pressure, valve means for controlling the supply of liquid nitrogen therefrom to nozzle means, and adjustable support means adapted to position the nozzle means in the vicinity of the grinding wheel so as in use, when the valve means is open, to direct liquid nitrogen towards the wheel or the workpiece or directly towards the point of contact between the wheel and workpiece, to reduce the heat generated by the grinding engagement of the wheel and workpiece.
7. A grinding machine as claimed in claim 6 wherein a work support drive means is provided for moving the workpiece support relative to the wheel during grinding to progressively present different parts of the surface to the wheel.
8. A grinding machine as claimed in claim 6 or 7 further comprising a rotational drive means for rotating the workpiece during grinding.

9. A grinding machine as claimed in any of claims 6 to 8 wherein further drive means is provided for positioning the nozzle means relative to the workpiece and the wheel, to enable the nozzle to follow any movement of the point of contact between wheel and workpiece during grinding.
10. A grinding machine as claimed in any of claims 6 to 9 further comprising a computer based control system wherein the control system is programmed to open the valve means and deliver liquid nitrogen coolant to and through the nozzle when the wheel is rotating and is in grinding contact with the workpiece, and to stop the delivery of the coolant when the wheel and workpiece are disengaged after grinding is completed.
11. A grinding machine as claimed in any of claims 5 to 10 wherein the valve means includes pressure reducing means.
12. A machine as claimed in any of claims 5 to 11 wherein the source is a pressure vessel and pressure sensing means is provided for generating a warning signal if the pressure in the vessel drops below a predetermined pressure.
13. A machine as claimed in claim 12 wherein the predetermined pressure is selected such that there is sufficient liquid nitrogen remaining in the vessel at that pressure, as to ensure that the grinding of a workpiece can be completed before the source is exhausted.
14. A machine as claimed in claim 12 or 13 wherein an interlock is provided to prevent resumption of grinding unless the source is replaced or replenished.
15. A machine as claimed in any of claims 10 to 14 wherein the control system controls the operation of the rotational drive and/or work support drive and /or the drive for rotating the wheel and/or the wheelhead drive means.

16. A machine as claimed in any of claims 10 to 15 wherein the control system also controls the operation of the further drive means so as to adjust the position of the nozzle during grinding so as to follow the movement of the wheel relative to the workpiece during the grinding.
17. A machine as claimed in any of claims 6 to 16 wherein the workpiece is a plate-like component and the workpiece support positions the component so that the edge thereof is presented to the grinding wheel for grinding.
18. A machine as claimed in any of claims 8 to 16 wherein the workpiece has a flat or profiled surface which is to be surface ground, and the workpiece support positions the workpiece so that the surface is generally horizontal and parallel to the X-axis of the machine.
19. A machine as claimed in any of claims 5 to 18 wherein the workpiece is formed from glass.